



PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

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| Applicant's or agent's file reference 03 01 691 285 | | FOR FURTHER ACTION | | See Form PCT/PEA/416 |
| International application No. PCT/DK2004/000374 | | International filing date (day/month/year) 28.05.2004 | | Priority date (day/month/year) 02.06.2003 |
| International Patent Classification (IPC) or national classification and IPC G01L19/08, G01P13/00 | | | | |
| Applicant DANFOSS AS et al. | | | | |
| <p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau) a total of 5 sheets, as follows:</p> <p><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p> | | | | |
| <p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p> | | | | |
| Date of submission of the demand 20.12.2004 | | Date of completion of this report 15.11.2005 | | |
| Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016 | | Authorized Officer Barthélemy, M Telephone No. +31 70 340-4376  | | |

INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITYInternational application No.
PCT/DK2004/000374**Box No. I Basis of the report**

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language, which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4)
 - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages

1-15 as originally filed

Claims, Numbers

2-4, 6-13 received on 20.12.2004 with letter of 01.11.2004

5 received on 30.09.2005 with letter of 27.09.2005

1 received on 25.10.2005 with letter of 19.10.2005

Drawings, Sheets

1/6-6/6 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☒ The amendments have resulted in the cancellation of:
- ☐ the description, pages
 - ☒ the claims, Nos. 14,15
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):

* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/DK2004/000374

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

| | | |
|-------------------------------|-------------|------|
| Novelty (N) | Yes: Claims | 1-13 |
| | No: Claims | |
| Inventive step (IS) | Yes: Claims | 1-13 |
| | No: Claims | |
| Industrial applicability (IA) | Yes: Claims | 1-13 |
| | No: Claims | |

2. Citations and explanations (Rule 70.7):

see separate sheet

Re Item V

**Reasoned statement with regard to novelty, inventive step or industrial applicability;
citations and explanations supporting such statement**

1 Reference is made to the following documents:

D1: US-A-4 177 680 (COLEMAN) 11 December 1979 (1979-12-11)

D3: EP-A-0 196 784 (IMPERIAL CHEMICAL INDUSTRIES PLC) 8 October 1986 (1986-10-08)

D4: WO 01/18517 A (TREEN ANDREW SHAUN, LAWRENCE CHRIS ROBERT, SWAN MARTIN, WILLIAMS JOHN) 15 March 2001 (2001-03-15)

2.1 The document D1 is regarded as being the closest prior art to the subject-matter of claim 1, and shows (the references in parentheses applying to this document) a pressure indicator suitable for indicating a pressure difference between a pressure P1 in a first chamber and a reference pressure (abstract; column 4, lines 1-12; figure 1), with a pressure chamber having an inflexible wall arranged at a distance from a membrane, said pressure chamber containing a fluid at reference pressure (figure 1; column 4, lines 1-12), and said membrane being arranged to separate said fluid from first chamber and to deflect upon a pressure difference between P1 and the reference pressure. Said deflection changes the distance between said wall and membrane and displaces the fluid in the pressure chamber (figure 1; column 4, lines 1-12). The indicator further comprises a second membrane separating the pressure chamber from a second chamber, said second chamber holding a pressure P2 (abstract; figure 1). Said pressure chamber is further sealed. The pressure indicator disclosed in D1 is a capacitive pressure sensor.

2.2 The subject-matter of claim 1 differs from this known pressure indicator in that the first is substantially transparent to electromagnetic radiation within a specific wavelength and in that said fluid is an incompressible liquid substance.

2.3 The subject-matter of claim 1 is therefore new (Article 33(2) PCT).

- 2.4 The problem to be solved by the present invention may be regarded as to provide a much simpler and cheaper pressure indicator for applications in which there is no need for an exact measurement, but rather to just indicate the sign of said pressure difference.
- 2.5 The solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons.
- 2.5a D1 discloses a capacitive pressure sensor and gives no hint to any implementation of transparent walls, i.e. to the use of a simple optical indication of the pressure difference.
- 2.5b Document D3 discloses an optical pressure indicator similar to the one defined in claim 1 in which only one pressure in a first pressure chamber is compared to the reference pressure. This indicator uses a Fabry Perot interference method which implies a complex measuring and processing equipment.
- 2.5c Document D4 discloses an optical pressure indicator in which a chamber containing a colored fluid and some visual patterns is formed by two diaphragms, one of which is transparent. When pressure is applied, said diaphragms get closer and the patterns appear on said transparent diaphragms. Said device, although very simple, does not indicate a pressure difference between said pressure and a reference pressure, nor includes a third pressure chamber.
- 2.6 The combination of a sealed cavity and the use of an incompressible fluid further gives the advantage of an amplification of the pressure difference indication.
- 2.6 Claims 2-13 are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

EPO - DG 1

APPLICATION NO: PCT/DK2004/000374

APPLICANT: DANFOSS A/S

20.12.2004

OUR REF: 03 01 691 285

(102)

5 NEW CLAIMS - NOVEMBER 2004 - MARKED UP VERSION

1. A pressure indicator for indicating a pressure difference between a pressure P_1 of a first chamber and a reference pressure, said indicator comprising a pressure chamber (1) having a sidewall with an inflexible first wall part (2) arranged at a distance from a flexible second wall part (3), the pressure chamber containing a fluid under influence of the reference pressure, the second wall part being arranged to separate the fluid from the first chamber (5) and to deflect upon a pressure difference between P_1 and the reference pressure, said deflection changing the distance between the first and second wall parts thereby displacing the fluid in the pressure chamber, the indicator further comprising a flexible third wall part (23) separating the pressure chamber from a second chamber (25), the second chamber holding a pressure P_2 , characterised in that at least one of the first, second and third wall part, relative to the fluid, is substantially transparent to electromagnetic radiation within a specific wavelength.
2. An indicator according to claim 1, wherein the pressure chamber comprises a first compartment adjacent the second wall part and a second compartment adjacent the third wall part, and a connecting channel providing fluid communication between the first and second compartments.

3. An indicator according to any of the preceding claims, wherein the second and third wall parts have equal surface areas towards the first and second chambers, respectively.
4. An indicator according to any of the preceding claims, wherein the second and third wall parts have equal stiffness.
5. An indicator according to any of the preceding claims, wherein the second and third wall parts are arranged in congruent planes.
- 10 6. An indicator according to claim 5, wherein first wall part is arranged adjacent to, and in a plane which is parallel to the planes of the second and third wall parts.
- 15 7. An indicator according to claim 6, further comprising illuminating means for projecting electromagnetic radiation within the specific wavelength from an outer side surface of the second wall part, through the second or third wall part, through the chamber and out of the chamber through the first wall part.
- 20 8. An indicator according to any of the preceding claims, having a stacked configuration comprising a first layer made of glass and a second layer made of silicon.
9. An indicator according to claim 8, further comprising a third layer made of glass.
- 25 10. An indicator according to claim 9, wherein the first and third layers have substantially plane surfaces towards the second layer and the second layer has a first surface

structure towards the first layer and a second surface structure towards the third layer, wherein the first surface structure forms the pressure chamber and the second surface structure forms the first chamber.

- 5 11. An indicator according to claim 10, wherein the second wall part is formed integrally in the second layer.

12. An array of indicators according to any of the preceding claims and formed in a three layer structure comprising two glass layers arranged on each side of
10 silicon layer.

13. A pump with an inlet and an outlet and comprising an indicator according to any of claims 1-11 arranged with the first chamber in fluid communication with the inlet and the second chamber in fluid communication with the
15 outlet to obtain indication of pressure difference between the inlet and the outlet of the pump.

Application no: PCT/DK2004/000374
Applicant: Danfoss A/S
Title: A Pressure Indicator
Date: 27. September 2005

EPO - DG 1

30. 09. 2005

New Claims 1 and 5 - Clean version

(100)

1. A pressure indicator for indicating a pressure difference between a pressure P_1 of a first chamber and a reference pressure, said indicator comprising a pressure chamber having a sidewall with an inflexible first wall part arranged at a distance from a flexible second wall part, the pressure chamber being completely filled with a fluid at the reference pressure, the second wall part being arranged to separate the pressure chamber from the first chamber and to deflect upon a pressure difference between P_1 and the reference pressure, said deflection changing the distance between the first and second wall parts thereby displacing the fluid in the pressure chamber, the indicator further comprising a flexible third wall part separating the pressure chamber from a second chamber, the second chamber holding a pressure P_2 , characterised in that the fluid is an incompressible liquid substance.

5. An indicator according to any of the preceding claims wherein the second and third wall parts extend in identical same planes.

Application no: PCT/DK2004/000374
Applicant: Danfoss A/S
Title: A Pressure Indicator
Date: 19. October 2005

EPO - DG 1

25. 10. 2005

(59)

New Claim 1 - Clean version

1. A pressure indicator for indicating a pressure difference between a pressure P_1 of a first chamber and a reference pressure, said indicator comprising a sealed pressure chamber having a sidewall with an inflexible first wall part arranged at a distance from a flexible second wall part, the pressure chamber being completely filled with a fluid at the reference pressure, the second wall part being arranged to separate the pressure chamber from the first chamber and to deflect upon a pressure difference between P_1 and the reference pressure, said deflection changing the distance between the first and second wall parts thereby displacing the fluid in the pressure chamber, the indicator further comprising a flexible third wall part separating the pressure chamber from a second chamber, the second chamber holding a pressure P_2 , characterised in that the first wall part is substantially transparent to electromagnetic radiation within a specific wave length, and where the fluid is an incompressible liquid substance.